Measures of Genetic Diversity Are Effective Tools for Evaluating Environmental Condition

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At their core, ecological risk assessments aim to evaluate the biological integrity and long-term sustainability of natural ecosystems. These are difficult objectives that will ultimately require development of novel indicators of ecological condition that are more accurate and more efficient than those currently available. The US EPA has invested in a research program to develop efficient measures of genetic diversity within aquatic species that more directly address the biological integrity and sustainability of aquatic communities. These measures bring new and powerful information to our understanding of aquatic ecosystems, including the identification of appropriate ecological assessment units, the linkages between environmental condition and population responses, and estimates of the future susceptibility of populations due to loss of genetic diversity. The utility of genetic diversity measures as indicators of ecological condition is being evaluated through a number of independent studies that range in scale from watershed-level assessments to large regional surveys. At the watershed level, DNA from historical fish tissue archives have been tapped to evaluate changes in genetic diversity over time in experimentally manipulated lake systems and in a polluted urban stream. At larger scales, genetic diversity measures have been incorporated into regional assessments of a midwestern ecoregion and the EPA's Mid-Atlantic Integrated Assessment area. Results to date have indicated a close relationship between levels of genetic diversity in fish populations and measures of overall habitat quality. A new study aims to tie genetic data with landscape-level assessments and fish population modeling efforts to perform a truly integrated assessment of trends in condition of aquatic resources. Partnerships with other labs and agencies have been fundamental to this effort; significant collaborators include the Canadian Department of Fisheries and Oceans, the Ohio EPA, and various US EPA laboratories, including the Atlantic Ecology Division of ORD/NHEERL, and the Ecosystems Research Division and Environmental Science Division of ORD/NERL. Ultimately, the approach will provide State and US EPA Regions with a powerful tool to assess ecological condition and relative vulnerability of aquatic resources, thereby enhancing our ability to maintain and restore the integrity of the Nation's waterways.

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